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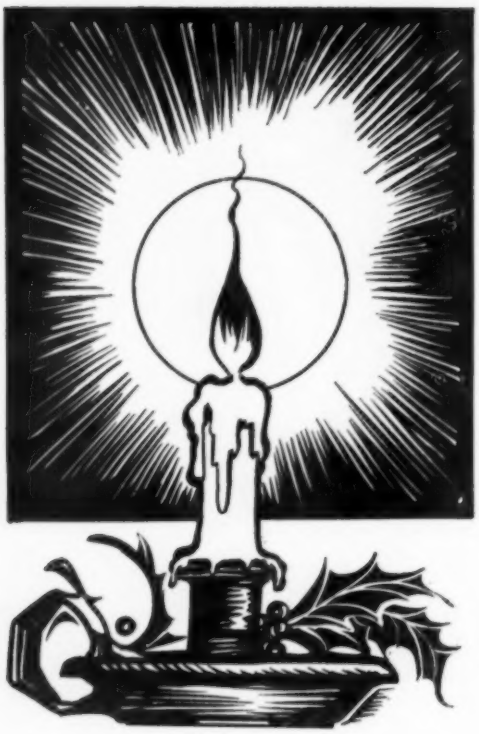

A VERY HAPPY

AND A PROSPEROUS NEW YEAR

SOFT-LITE LENS

AMERICAN JOURNAL OF OPTOMETRY

VOL. 9 JANUARY, 1932 NO. 1

REPORT OF A CASE OF TOTAL COLOR BLINDNESS*

R. H. Peckham, B. A.
Rochester, N. Y.

Dr. Wyckoff, Optometrist, of Chagrin Falls, Ohio, introduced the author to this case, Mrs. Marie La C————————. With his assistance and that of Dr. R. M. Peckham, of Rochester, N. Y., a preliminary study has been made, of which this is the report. It is the intention of the author to make a far more intensive study at a later date.

Sir J. H. Parsons, in his book "Introduction to Colour Vision." Cambridge University Press, 1924, states that 84 cases of total color blindness have been reported between 1777 and 1916. This rare phenomenon of total color blindness is called "monochromatic vision" or "achromatopia." The cases are described as having no color perception at all. The condition is congenital, appears to be hereditary, and as yet no cure or correction is conceivable. Certain other ocular defects accompany the achromatopia: notably, bad central vision, near 6/xviii Snellen; marked photophobia; and nystagmus. The refractive error is generally myopic, but correction does not improve vision. The spectrum appears as a monochromatic strip, with no color distinctions, but with varying luminosity in different parts. (op. cit. p. 199.)

Mrs. La C———————— has, as far as the examiners could ascertain, no color perception whatever. She perceives abstract color as grey, and the Ishihara designs are meaningless, with the exception of No. 1. Following Parsons' descriptive outline, we find the subject to have been congenitally color-blind. We have no data concerning her parents. Her central vision, June, 1931, was 25% as measured by the Clason. There was marked photophobia, but no nystagmus has been recorded. The Rx, by static skiametry, was:

O. D. —1.75 D. Sph. —2.25 D. Cyl. ax. 5
O. S. —2.00 D. Sph. —1.25 D. Cyl. ax. 5

*Submitted for Publication September 22, 1931.

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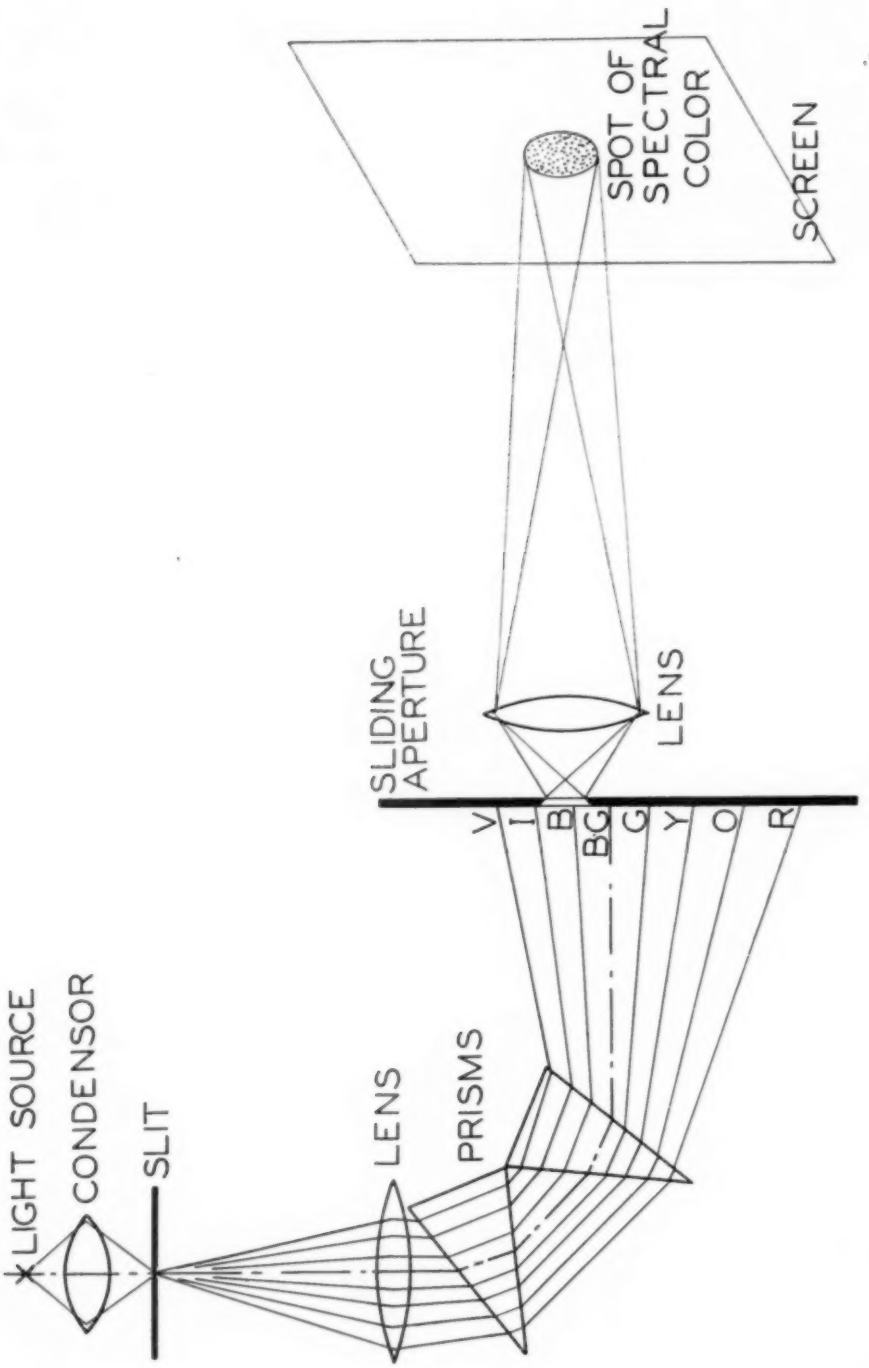
SCREEN
SPOT OF SPECTRAL COLOR
LENS
SLIDING APERTURE
V
I
B
BG
G
Y
O
R
PRISMS
LENS
SLIT
CONDENSOR
LIGHT SOURCE

FIGURE 1

This correction has been worn for a year, without any improvement in letter vision. The prescription has, however, reduced the photophobia until there is no discomfort.

The first attempt to study this subject was through the Ishihara tests. The first card, a figure "12" of red dots on a background of grey dots, was understood correctly by the subject. The red spots were darker than the background. The rest of the cards were a hopelessly jumbled mass of grey and black spots.

For a more detailed and accurate study spectral color was projected with the apparatus shown in figure one. The light source was a 250 W. Mazda bulb. This is focussed into a narrow slit, 1mm. by 2cms., the slit becoming the virtual source of light. This light is next focussed through the prisms onto the card bearing the sliding aperture. The aperture is moved back and forth through the series of colors, isolating a single group into a nearly mono-chromatic band. The aperture is imaged onto the screen, giving an area of nearly pure and quite brilliant spectral color about an inch in diameter. The intensity of this spot of color can be controlled conveniently by an iris diaphragm at any of the lenses in the series.

A scale of shades as shown in figure two was devised by Dr. Wyckoff when he discovered that the subject attempted to describe her perception of colored objects in terms of greyness. It consists of a graded series of greys, terminating in black and white. The spots of color from the monochromator described above were "matched" by the subject with these greys. Because the subject has very acute intensity perception, in black-white, she distinguishes differences between the greynesses of the colors and those of the chart. Thus: dark red is lighter than shade three and darker than shade four. Both yellow and green are described as lighter than shade one, darker than white. This difference was not in the intrinsic chromatic value of the spectral spot as referred to the grey series, but in differences of brightness smaller than those shown in the series of Dr. Wyckoff.

On the right in figure three are our names of the colors which were applied to the adjacent shades. For example, when violet spectral color was projected, the subject indicated shade five as being the nearest approximation. The examiners then wrote "violet" opposite shade five. It is necessary to note that, while being herself unaware of the fact, the subject identified both yellow and green as the same shade, and later indigo and light red as both like shade six. With chromatic sensation absent these pairs of color have the same brightness to her, that is, the same luminosity.

The spectrum must appear, by inference, to be a series of brightnesses as in figure three. A careful study of this schematic spectrum throws some light upon the perception of colored natural objects. A field of dandelions with their startling contrast of yellow flowers and green background, appears to her as a field of *WHITE* flowers on a *LIGHT*

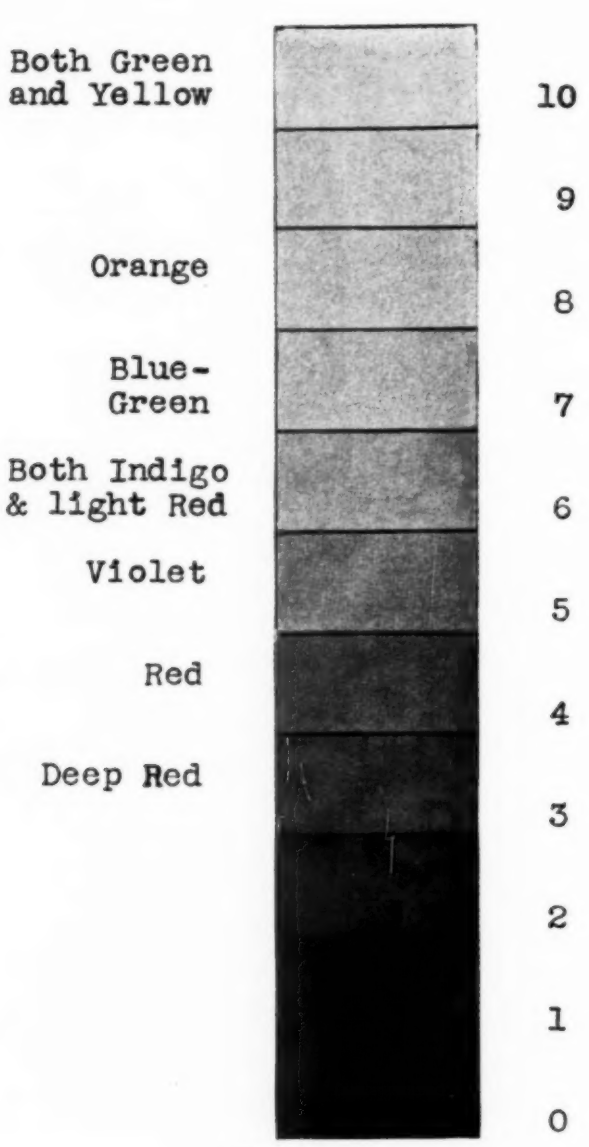
Colors matched as in this column
Relative intensity value
Both Green and Yellow
Orange
Blue-Green
Both Indigo & light Red
Violet
Red
Deep Red
10
9
8
7
6
5
4
3
2
1
0

FIGURE 2

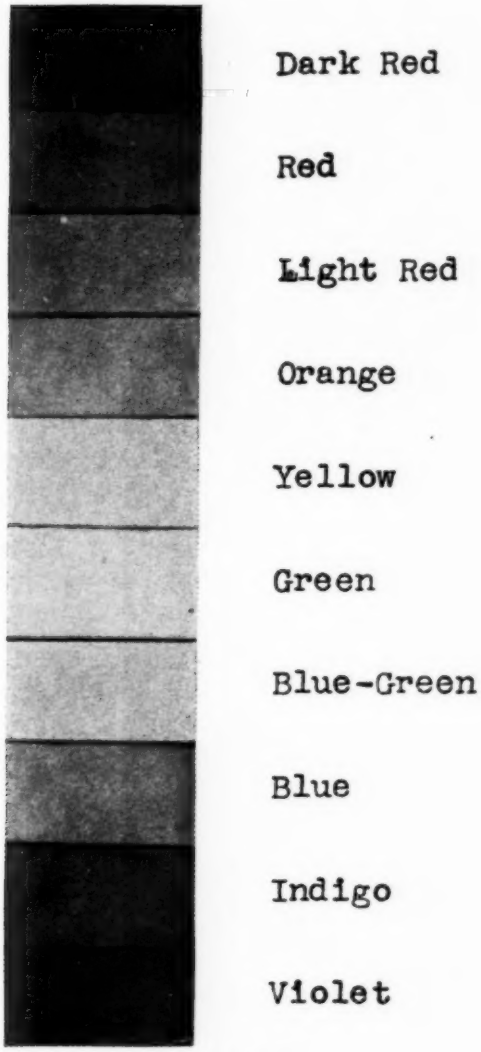

FIGURE 3

GREY background. A dark red rose approaches a *DARK GREY* blossom on a *LIGHT GREY* bush. A violet appears as a black flower on a grey stem. The dress the subject was wearing appeared to the examiners as of white cloth with brilliant red spots; to the subject it was white with grey spots. A purple sash with this dress would appear to us as rather harsh taste; but to her the "black" ribbon would be a pretty relief to the grey spots. She is naturally forced to depend upon the chromatic perception of her friends in selecting costumes.

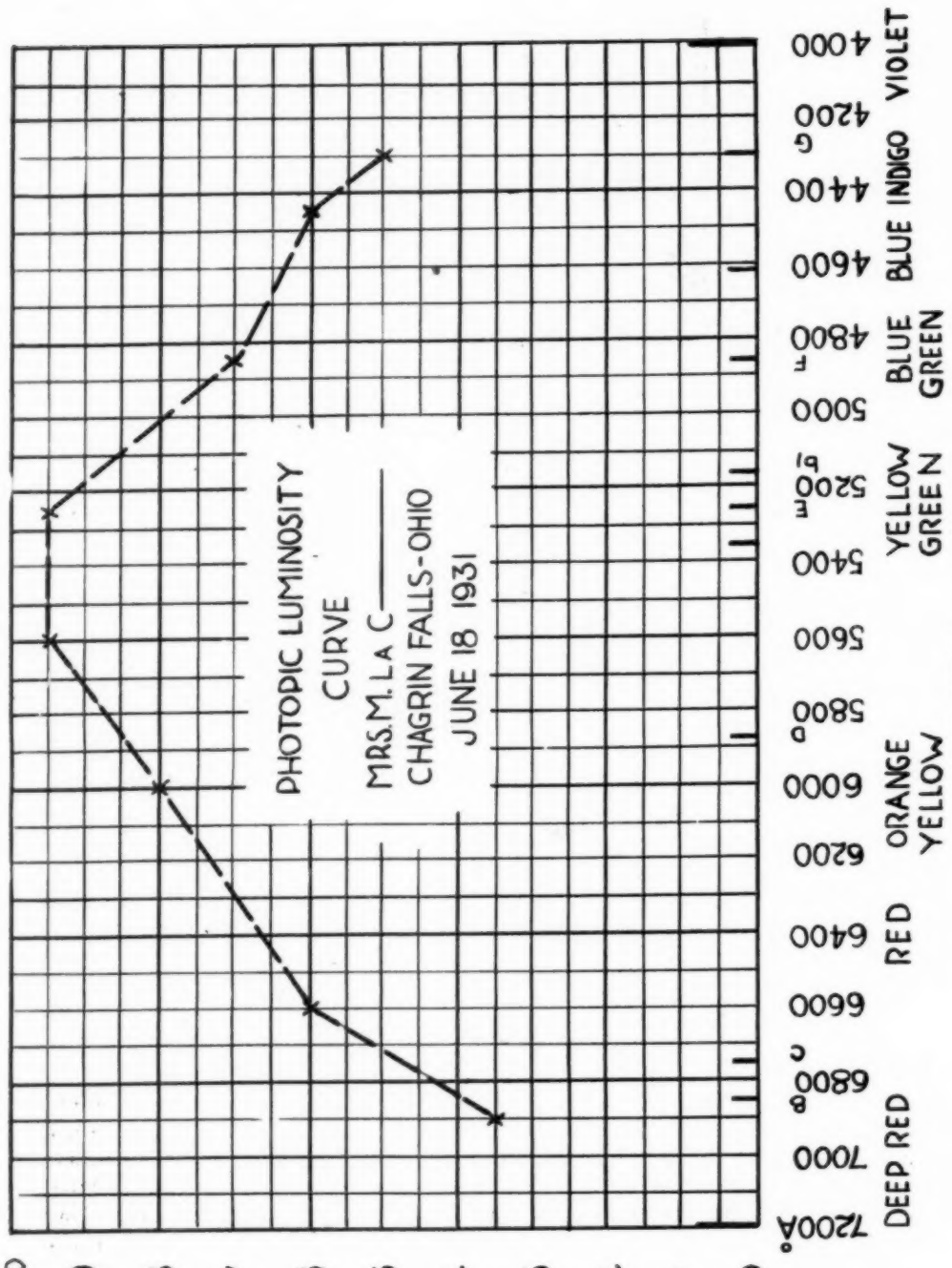
PHOTOPIC LUMINOSITY CURVE
MRS. M. LA C
CHAGRIN FALLS-OHIO
JUNE 18 1931
10
9
8
7
6
5
4
3
2
1
0
7200Å
7000
6800
6600
6400
6200
6000
5800
5600
5400
5200
5000
4800
4600
4400
4200
4000
DEEP RED
RED
ORANGE
YELLOW
YELLOW
GREEN
BLUE
GREEN
BLUE
INDIGO
VIOLET

FIGURE 4

From this discussion we begin to comprehend the perceptive life of the color-blind. Living in an achromatic world they are only able to develop abnormally acute shade differentiation with which to compare the mysterious allusions of their friends to "blue" skies and rainbows. They cannot even see a "rainbow."

An approximate "luminosity-curve" can be prepared from the data thus obtained. This curve is shown in figure four. The subject was not dark-adapted during the test, hence the title "Photopic Luminosity Curve." Along the base-line, as abcissae, are wave-lengths of light in Angstrom units. The letters A, B, C, etc., represent the positions of the Franhofer lines, used in identifying color with wave-length. The color groups are printed below. Along the vertical ordinate is the arbitrary scale of relative intensity derived from the series of grey on the card of Dr. Wyckoff. The points of the curve were determined thus: deep red was described as between shades 3 and 4, red as 6, orange as 8, etc. Through these points the curve was drawn. From this curve we can approximate the shade or intensity values of other colors. Canary yellow would be between 9 and 10, Irish green about 8.

It is hoped that this description will help optometrists to understand the problems of the totally color blind, and will perhaps result in further reports of such cases. Great care must be taken against confusing total color-blindness with partial color-blindness. This report in no way attempts to describe the more usual partial color-blindnesses.

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SPECTACLES—LEGENDARY AND HISTORICAL*

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Part 1—Legendary

What is the when, where and how of the invention of lenses—that is, lenses made of glass and used as an aid to vision.

It is interesting to the writer to know the origin of lenses and it is because of that interest that a search has been made in ancient history to ascertain whether the Chinese or the Caucasians had the first conception of lenses to aid vision.

Because of the scarcity of actual knowledge concerning this phase of our profession, the writer has spent over two years in the attempt to unearth all authentic data on the subject. This paper is the result of this work.

The London Times of October, 1929, published an article by O. D. Rasmussen in which he said, "I have been conducting a research in the matter for the past twenty years and as a specialist in eyesight and optical work I am in a position to know of the Chinese case." Rasmussen further states that the Chinese knew nothing of scientific optics and arrived at the use of spectacles purely by accidental experience or empirical methods.

In the 1930 Year Book of the New York State Optical Association, Dr. Charlesworth P. Rakusen of Shanghai had a paper entitled "Optics in China," in which he says, "Outside of the International Settlements of Shanghai, outside of the other Treaty Ports, and also throughout China . . . one can find the native opticians, plying their trade in exactly the same conditions as they did hundreds of years ago. The trade is generally guarded with the utmost secrecy of manufacturing methods and handed down from father to son.

"According to the records of Marco Polo, one of the earliest foreign visitors to China, the Chinese are reputed as the earliest users of spectacle lenses for optometric and therapeutical purposes, and such usage is reputed to date prior to Marco Polo's travels in the year 1260 A. D.

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*A paper delivered May 18, 1931, before the New York-Pennsylvania Academy of Optometry.

"At that time, even as now, the native opticians made their lenses from crystals, never from glass. The crystal is found in many parts of China in rough pieces about 10 inches long, 2 inches wide and 4 to 7 inches in thickness.

"Crystal is generally found in three main colors, crystal, smoke and tea . The Chinese regard them as possessing great medicinal value, and in fact, the Chinese name for the tea colored variety is translated into a phrase indicating that the crystal contains medicinal liquid."

About three years ago, the Gest Chinese Research Library at McGill University in Montreal obtained from a private collection in Peiping a first edition of the oldest printed Chinese encyclopedia, entitled *Chin Ting Ku Chin Tu Shu Chi Cheng*. This work is estimated to contain three to four times as much material as the 14th edition of the Encyclopedia Brittanica. The compilation beagn in 1686, occupied 40 years and when printed consisted of 5000 volumes, exclusive of 20 volumes of index. From this two tons of material, it seemed as if there could be found some authority for crediting the Chinese with the discovery of optical lenses of glass. However, a letter addressed to the Library brought the information that a similar request had been received previously and that the desired information could not be supplied. As yet, it has not been possible to find out who the person was that made the "similar request," or what knowledge he gained, if any.

The Congressional Library has a reprint of this encyclopedia and a reply from Arthur W. Hummel, Division of Chinese Literature, on the same query is in part, as follows:

"The Chinese Encyclopedia to which Dr. Haynes asks us to refer offers no warrant for believing that either glass or spectacles were invented by the Mongolian rather than by the Caucasian race. In fact this encyclopedia clearly states that glass came from the West through India. There is a record of glass having been sent as tribute to China from the West about 954 A. D. Glass appears in China earlier than this, but in practically every case as imported from the West. The Chinese word for glass is *po-li*, and is undoubtedly of foreign origin, possibly Persian. Our English word 'polish' perhaps comes from the same root. Dr. Berthold Laufer in his work 'Burning Lenses in China and India' clearly traces lenses to India, and from there to the West."

Upon taking up this same question with the Field Museum of Chicago, I was referred to the work of Berthold Laufer on "Burning Lenses of India and China." No copies of this book are available in this country, but a copy was secured from the publishers in Leiden, Holland.

Laufer says, "Crystal lenses wherever employed in ancient times served for one main purpose exclusively—the optical method of fire making. This method is not found among any primitive tribes of the world, but is restricted to the highly advanced nations settled around the Mediterranean and to the peoples of India and China."

W. Hough in his report to the National Museum at Washington in 1890, on the subject of ancient fire-making supports this statement of Laufer by saying that the priests and alchemists of the ancient cultured nations knew of this method of producing "pure fire" and used it as a mystery.

It seems reasonable to assume that the very first use of lenses was for the making of fire and that only the more advanced peoples of the Mediterranean countries, India and China, had this knowledge. With this in mind, a few of the references to the use of burning lenses in the ancient civilized world are given, showing the remarkably few ancient references which might be said to show that in those times anyone had the conception of, or realized the value of, the use of one of these burning lenses for the assistance of vision. Also to show by these references that there is no authentic proof for the statement that China first made use of spectacles.

Laufer remarks that Layard in 1845 discovered in the palace of the Assyrian king, *Ashur-Nasir-Pal*, who lived 885-860 B. C. at Nineveh, a rock crystal lens of planoconvexity one and one-half inches in diameter with a focus of four and one-half inches, cut much like our own burning glasses, although crudely, and which may well have served as a burning lens. Even if the old Assyrians and Babylonians did possess the art, it became lost afterwards, for to the Ancient Hebrews and Egyptians, spectacles were unknown.

The earliest well-authenticated literary testimony for the use of a lens appears in the famous "Comedy of the Clouds" written by *Aristophanes*, the Greek playright, in 423 B. C.

Strepsiades, who has run up a debt of five talents, wishes to dodge his obligation by destroying the bill of complaint recorded in wax by operating upon it with a burning lens.

The following dialogue ensues between *Strepsiades* and *Socrates:*

Strepsiades: I've hit the nail
That does the deed, so you will confess.

Socrates: Out with it!

Strep: Good chance but you have noted a pretty toy, a trinket in the shops, which, being rightly held, produceth fire from things combustible.

Soc: A burning glass, vulgarly called.

Strep: You are right; t'is so.

Soc: Proceed.

Strep: Put the case now your bailiff comes,
Show me his writ—I standing thus, d'ye mark me,
In the sun's stream, measuring my distance, guide
My focus to a point upon his writ,
And off it comes *in fumo!*

Soc: By the graces,
T'is wittingly devised.

Even at this early date the Greeks knew of glass and had a word for it, but there is nothing to show that lenses were used for seeing.

Pliny in his "Natural History" written sometime between 23 and 79 A. D. makes a reference to burning glasses and says, in his chapter on Crystal, "I find it stated in medical authors that crystal balls placed opposite to the sun's rays are a most useful contrivance for cauterizing the human body." Here is seen a definite reference to the use of lens by the medical men, but there is again nothing to indicate that these lenses had ever been employed to aid the vision. Chinese physicians also made use of crystal lenses for this same purpose, but at a much later date.

Quoting a paragraph from Laufer's work:

"The ancients, accordingly, employed optical lenses in medicine for cauterizing the skin, and in the religious cult for securing sacred fire. The opinion has been expressed also that they served the purpose of magnifying objects, as shown by this reference to a passage in Seneca, 'That letters, however, minute and indistinct, appear larger and clearer through a glass ball filled with water.' Lessing has ingeniously and conclusively demonstrated that there is a wide step from a magnifying sphere to a magnifying-lens, and that the causes of the enlargement were sought by the ancients, not in the spherical shape of the glass, but in the water with which it was filled. More over, the passage of Seneca proves nothing beyond a personal experience of the author; and there is, in fact, no ancient tradition regarding specular or magnifying lenses."

Lenses have been excavated in Pompeii, Nola and Mainz, which are claimed by J. Marquart to have been magnifying lenses, but there is nothing to support this claim.

It seems advisable here to trace very briefly the progress of the burning lenses, for it is to be shown that China could not have used spectacles or originated legends concerning them when they did not even learn of an elementary form of lens until a comparatively late date.

Dr. E. Hill in the Opthalmic Record, Vol. 23, 1914, stated that it is said that a Chinese emperor used lenses as early as 2283 B. C. to observe the stars. Laufer points out that this is not possible as a lens could not have been manufactured at that time as the materials required for it, glass or rock srystal, were unknown in China, and moreover, the Chinese in this case lay no claim whatever to a lens. This point is covered by reference to the oldest historical record of the Chinese, the *Shu-King*, in which the astronomical activity of the Emperor *Shun* is spoken of. He is said to have made use of an instrument of jade, but no description of this instrument is given. In whatever form this stone, hard and not transparent, may have been, it is difficult to believe that it had anything in common with a lens.

In 485 A. D., a jade mirror was found in an ancient tomb of the

Chinese King *Suan* who lived from 827 to 782 B. C. and from the vicinity of this tomb comes stone suitable for mirrors.

Liu Ngan, a member of the Chinese imperial family, philosopher and alchemist, who died in 122 B. C., is credited by Laufer with the statement that "When the mirror is held toward the sun, it will ignite and produce fire." This man repeatedly mentions mirrors, but neither he nor his contemporaries mention lenses for the reason that lenses did not show up on the horizon of the Chinese until the seventh century A. D.

Burning reflectors were known to the Greeks. Euclid about 300 B. C. mentions them in his works; and Alchimedes is believed to have burned the Roman fleet at Syracuse in 214 B. C. with these reflectors—probably a myth.

Dryden's translation of Plutarchs Lives, Vol. 1, Page 127, in the life of *Numa* it is said, "He was guardian of the Vestal Virgins, the institutions of whom, and of their perpetual fire—and in case by any accident it should happen that this fire become extinct, then, afterwards, in kindling this fire again, it was esteemed an impiety to light it from common sparks or flame or from anything but the pure and impolluted rays of the sun which they usually affect by concave mirrors."

It is noted that no mention is made of the material of which this mirror is made. But the translation does tell exactly how the mirror is made. "Effect by concave mirrors of a figure formed by the revolution of an isosocles rectangular triangle all the lines from the circumference of which meeting the light of the sun, they can collect and concentrate all its rays in a center, by holding it in at this point of convergence."

The confusion existing between mirrors and lenses in use in China can be cleared by referring to the first use of the Chinese term meaning "fire-pearls." The first historical mention of this term is made in the Annals of the *T'ang* Dynasty (618-906) where they are connected with a tribe of Malayan or Negrito stock, styled *Lo-cha*. A difference of opinion exists among authorities as to the exact location of this country, but it appears certain that it is located in the Malay Peninsula, southeast of China and near to the island of Java. Laufer gives the quotation, "Their country (Lo-cha) produces fire-pearls in great number, the biggest reaching the size of a fowl's egg. They are round and white (by white, is believed to mean colorless—C. K. H.) and emit light at a distance of several feet. When held against the rays of the sun, mugwort and rushes (cauterizing materials) will be ignited at once by fire springing from the pearl." From this description it can be seen that the fire-pearls were convex lenses, probably made of quartz or rock crystal and were used only for the medical purpose of cauterization.

Going farther back in the attempt to determine if the people of *Lo-cha* had sufficient intelligence to make these lenses, we find that E. H. Mann, a noted anthropologist, said in 1883 that the *Lo-cha* were not acquainted with the fact that quartz or rock crystal could be used in

place of flint for striking fire and, therefore, it seems highly improbable that they could have made the lenses.

Regarding ice lenses, Laufer says: "Flakes of ice if cut into the form of a convex lens may serve as a burning glass." The Chi ese have had this experience; he believes it was only after and in consequence of the introduction of foreign crystal lenses, that the experiment with ice lenses could have been conducted in China. The idea was not conceived by the Chinese as a result of a natural observation or optional study, which they never cultivated, but ice was resorted to as a makeshift and substitute for the rare rock crystal on the theory of natural philosophy that the latter is transformed ice: Crystal and ice being products of a like origin, were thought to be able to bring about the same effects.

Another Chinese writer calls them *shui-tsing*, water essence—a name for rock crystal.

Demely in his book *Laperdaires Chinois*, says "Neither the Chinese nor the Indians of India have ever made use of magnifying lenses, but both peoples were familiar only with lenses for fire-making." *Li Shi Chen* says that the red variety of rock crystal is supposed to attract fire, while the white variety of the same stone attracts water and fire at the same time.

In the same manner as among the ancients, the speculations of the Chinese concerning the nature of rock crystal were divided between the opinion that, on the one hand, it was the essence of water (owing to the outward resemblance to ice) and on the other hand, the essence of fire, because when struck by steel it yields sparks or when used as a lens, produced fire.

Diodorus Siculus of the first century B. C. expresses the view that crystal originates from purest water hardened into ice not by cold, but through powerful effect of solar heat.

Again referring to the Annals of the *T'ang* Dynasty through the medium of Laufer's work, we learn that in 641, Magadha in India sent fire-lenses to the Chinese court as tributes and, further, that Kashmir in India produces fire lenses.

Huan-Tsang, a celebrated pilgrim, in 646, makes a similar statement in his memoirs.

There are still other references from which it can be concluded that burning lenses were made in India and that they were first introduced into China in the early part of the seventh century A. D. Therefore, the statement can be made that the Chinese did not know of even the simplest form of lens for any purpose before this time and, moreover, any legend having to do with lenses (not mirrors) could not have had its origin earlier than this.

The writer has shown that China first became acquainted with burning lenses in the seventh century and that before this date, they were used in India. The Arabic invasion of India was in the eighth century

and, therefore, the conception of lenses can not have been imported from Arabia.

It will have been noticed that up to this point there has been no references found leading to the idea that any of the more advanced peoples had the conception that lenses could be used to aid human vision—except as this idea is contained in certain legends existing in China.

One of the earliest references is contained in the writings of Confucius, about 500 B. C., where it is said that he aided one of his workers by supplying a pair of spectacles. But it must be remembered that frames made from the shell of the sacred tortoise were worn as it was thought that such a frame would cure diseases of the eye. And as it has been pointed out that the Chinese were not familiar with even an elementary form of lens until many years later, it is difficult to understand how they could possibly have made use of a lens for vision in these frames. At least, the frames were worn for religious or ornamental purposes and while there were occasionally pieces of crystals inserted in these frames, there has been nothing found to show that these pieces of crystal were known to have any value for correcting vision or that vision could be assisted by any means other than drugs. Therefore, while the Orientals used frames containing bits of a transparent substance, they did not have the idea of actually aiding or correcting sight and, hence, it does not seem reasonable that they should have credit for the first use of opthalmic appliances, or glasses, as the term is used by us today.

Burning lenses were first introduced into China in the early part of the seventh century A. D. It is not reasonable to suppose that had lenses for the aid of vision been known and so been made use of that in the interval of time of twelve centuries, 500 B. C.-700 A. D., the very wise men of China would not only have used, developed and spread such a blessing to other parts of the world? Two hundred years after the death of Confucius, *Chin Shih Huang Ti*, known as the First Supreme Emperor, decreed the burning of the books, and the destruction of all the literature—history, scholarship, philosophy and poetry, was carried out under the penalty of death. About one hundred years later—145 B. C., a copy of Confucius' writing, "The Book of History" was found in the walls of his old home. Nowhere in that book of philosophy can be found any mention of spectacles or aid to vision by any means of, or by, lenses.

According to the early Chinese legend, the first glasses were made by *Cho Tso*, who lived on a sacred mountain in the middle Kingdom thousands of years ago. The lenses for his glasses, *Cho Tso* made from crystals which the gods had left for him; ground them with sand from the sacred rivers; and framed them from shell from the backs of the sacred tortoises that swam the mountain streams. Wearers of these wonder glasses from the sacred mountain could do marvelous things—they could see through the darkness, look into the future, or spy out the secret places where treasure was hidden in the earth. But one day *Cho Tso* himself looking through his own glasses, spied out the day of his

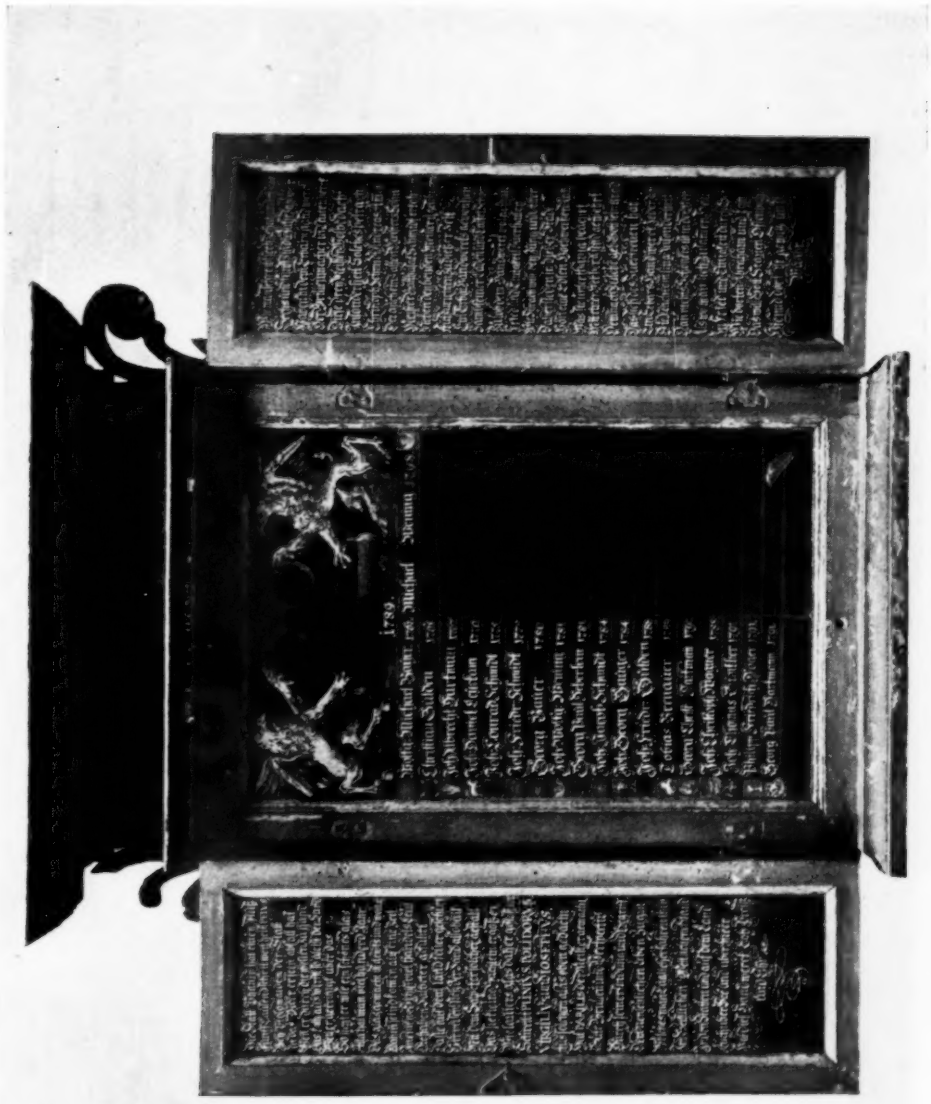

Fig. 1. Cabinet of the Spectacle Makers Guild at Nurnberg.

approaching death and true to the vision of the magic lenses, death came on the appointed day. This tradition has been the background of all spectacle making in China, and glasses have continued to be linked to a fund of myth and magic.

Tradition says that the tortoise is a sacred animal, and its sacred shell was believed to supply good fortune and long life with every pair of spectacle rims. The lenses made from rock crystals or quartz, or from other lucky stones, tradition claimed, still further insured the continued health and happiness of the wearer, and cured various diseases of the eye. And such glasses were regarded as badges of superior rank and intelligence. Many similar ideas and customs, based on the superstitions of the early days of glass making, have lingered on in China almost to the present day. It was considered very rude at any time to talk to a person while one had his glasses on, and particularly was it a sign of grave disrecpect to wear them in the presence of a judge. The judge himself, however, would have his glasses on as an aid to his dignity, if not for his eye-sight.

Nor have these customs been confined to the Orient. In Germany, too, it was long the custom to remove one's glasses when speaking to a superior. And in Spain glasses were considered an ornament and as a mark of rank and nobility.

As time went on, there came a gradual development of the idea that if a pair of glasses indicated intelligence, that a larger pair of glasses would indicate more intelligence. The frames accordingly grew larger and larger.

We have now covered the legendary part of this history of spectacles and certain conclusions present themselves. While it is common belief that spectacles, as we know them, had their origin in China, there is nothing of value to support this. China admits that her knowledge of burning lenses came from *Lo-cha*, which means through India. Of course, ancient Greece has the chronological priority for the invention of burning lenses, as there is the well established date of 423 B. C. when Aristophanes wrote his "Clouds." The knowledge of the invention probably passed from Greece to the Orient of the Roman Empire and thence to India somewhere between the fourth and the sixth centuries, and was passed on to China about the first of the seventh century.

The conception of the idea that a glass, or crystal lens when held in the rays of the sun would focus the rays and so enable one to make fire, is the primary step towards the invention of spectacle lenses to aid human vision. It has been shown definitely that the Greeks had knowledge of burning lenses many centuries before the Chinese. It is inconceivable, therefore, that the Chinese could have made any form of lens to aid vision before the seventh century, for they did not kr ow the value of this elementary form of lens prior to this time.

From the seventh century up to the time that Marco Polo reported that lenses for optometric purposes were in use in China (about 1260 A. D.), there is no evidence to show that the Chinese made or developed

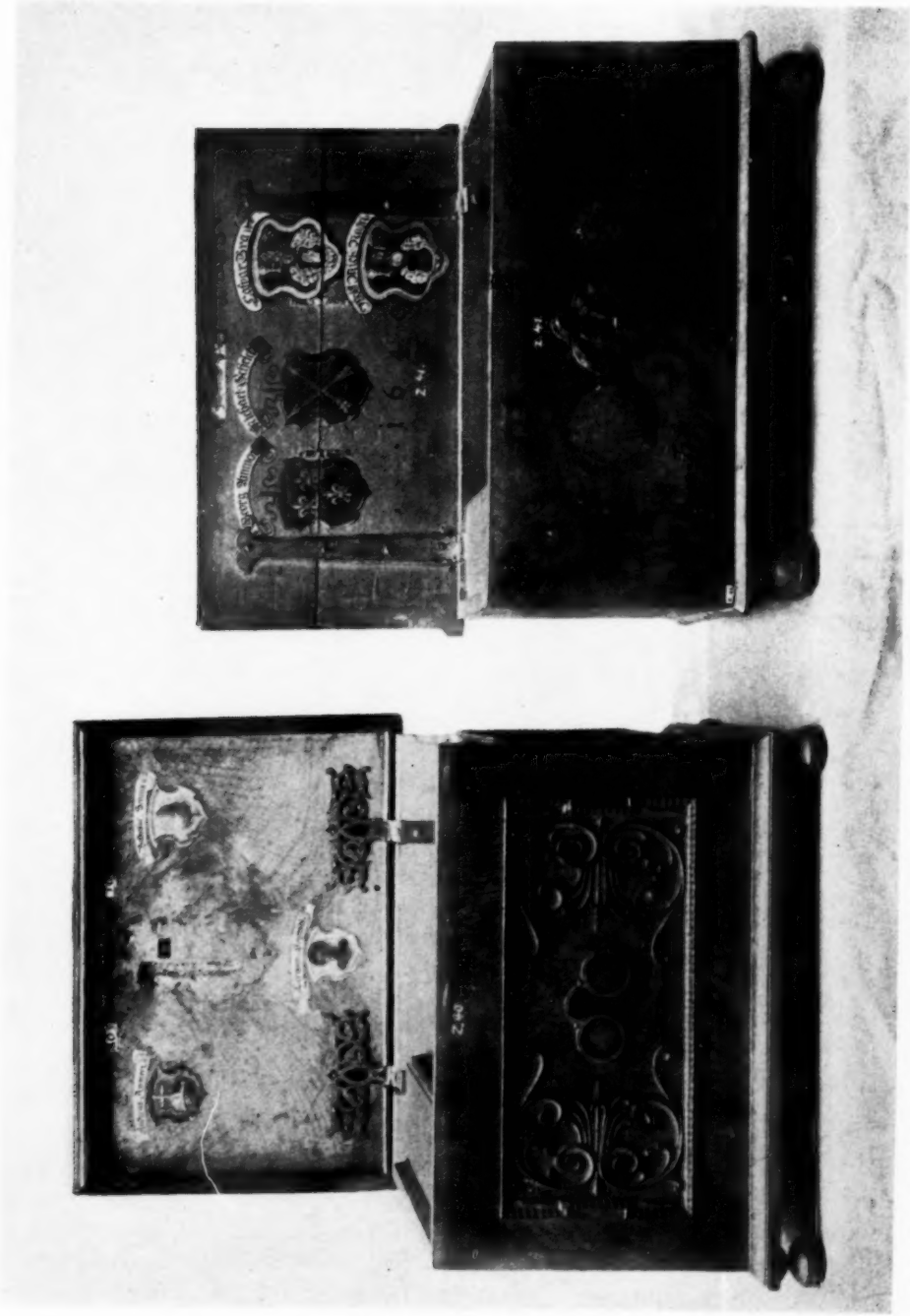

Fig. 2. Two Chests belonging to the founders of the Spectacle Makers Guild at Nurnberg. These chests bear the dates 1640, 1733 and 1656.

glasses by themselves. Trade routes to the west were open and, as it will be shown later, spectacles making use of the refractive value of lenses were known in Europe, at the middle of the thirteenth century. Therefore, it is extremely possible that spectacles may have been introduced into China, rather than developed there. As the Chinese writings do not credit their own people with this discovery, the negative evidence in this case seems conclusive that China can not be given credit for the first use of optometric lenses.

An interesting sidelight is given here on the therapeutical value ascribed by the Chinese to crystal lenses. In the first part of this paper attention has been called to the remark of Dr. C. P. Rakusen that the Chinese regard crystal as having great medicinal value and that the Chinese name for the tea colored variety means "the crystal containing medicinal liquid." In its native state, the pencils, or lumps, of crystal are remarkably free from flaws or inclusions, highly transparent and having faces sufficiently plane to allow objects to be seen through them without much distortion. It is well known nowadays that any substance which may be used in front of the eye to reduce glare will make vision easier. This fact, then, makes it readily understood why a Chinese, relieved from glare by looking through his slabs of tea colored crystal, would assign medicinal properties to it. This may have been the origin of the myths relating to the discovery of spectacles by the Chinese, but it must be remembered that such contraptions cannot be classed as opthalmic appliances any more than a pair of today's glazed sun glasses can be called spectacles.

Part 2—Historical

In this legendary research, the writer has endeavored to show that the Chinese cannot be given the credit for the first use of glasses as opthalmic appliances. The question then naturally arises as to when glasses were originally used as aids to vision, and by whom.

During the first twelve centuries of the Christian era, there is no reference in any language which can be used to show that mechanical aids to sight were known. Glass was known and used extensively. The basic ideas of optics were known, as is shown by the use of mirrors and lenses for fire-making and cauterization. But if anyone had made use of a glass or crystal lens for opthalmic purposes, the discoverer did not record this and probably kept the fact strictly to himself. It is not difficult to understand why this should have been done, if it was, for in those times any such discovery would have been termed "black magic" and the user would have soon found himself under sentence of death. Roger Bacon (1214-1294), called the "father of science," was imprisoned at different times, for 22 years, or nearly one-third of his life, for writing and advocating scientific discoveries. Bacon is said to have known convex lenses and was the first to record and mention concave lenses, but no mention is made of the use of concave lenses for the improvement of vision until the first recorded use by Pope Leo X (1475-

1521) who is said to have used a concave lens. An oil painting by Raphael in the Pitti Palace in Florence shows clearly a single concave lens being held in his hand—the concavity being plainly shown by the reflection.

Porta in 1558 explained the action of a concave lens upon a short-sighted eye . . . and one hundred years late Zahn is credited with grinding of concave lenses.

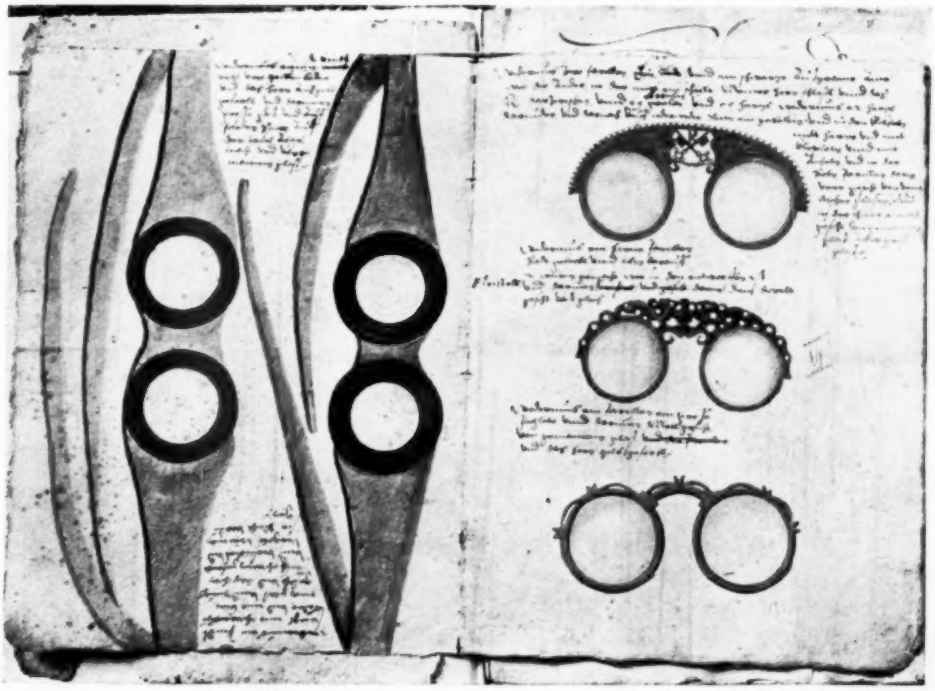

Fig. 3. Reproduction of pages from the Regensburg Book, showing styles of spectacles and reading glasses. Note the elaborate carving on the frames.

Speculation on this point makes it appear that the alchemists and holy men were interested only in using lenses for the purposes of fire-making and cauterization and, therefore, there is nothing to indicate that these men had any conception of the value of such a negative lens to assist the sight even among a people having a high percentage of myopes —the Orientals being notoriously near-sighted.

Galileo (1608) appears to be the first person to try the effect of a system of lenses—that is, one or more concave lenses used in conjunction with one or more convex lenses.

Certainly it seems reasonable to assume that if the results obtainable with a system of lenses had been discovered earlier it would have been recorded or made use of by the miracle men.

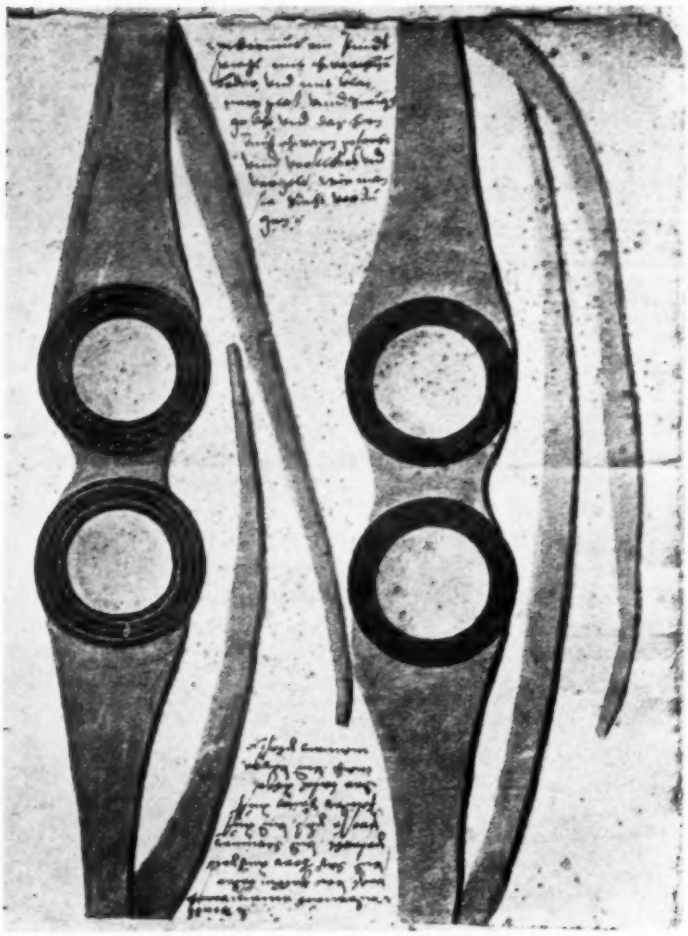

Fig. 4. Enlargement of the left hand page shown in Fig. 3. These are straps of leather with lens inserted in rims. The handwriting is very difficult to decipher.

To follow closely the development of lenses, historically, it is necessary to review a few paragraphs of the writer's former paper in the American Journal of Optometry, February, 1929.

Molyneaux, the historian and authority of the life and writings of Roger Bacon says that Bacon "Did perfectly well understand all kinds of optical glass and knew likewise the manner of combining them so as to compose such instruments as the telescope." "Marvelous are the conclusions," Bacon said, "That may be formed by glasses concave and convex." In 1276 he said that glass lenses were very useful to those whose sight had become impaired. This is the first positive mention of

spectacle lenses for the improvement of sight—and he was the first to mention concave lenses.

In a manuscript said to be dated 1289 and which was published by Dr. Redi in 1648, this passage is found, "I am so debilitated by age that without glasses, known as spectacles, I would no longer be able to read or write. These have lately been invented, much to the benefit of poor people whose sight has become weak." The author's name was not given but there is reason to believe that the author refers to Bacon's discoveries.

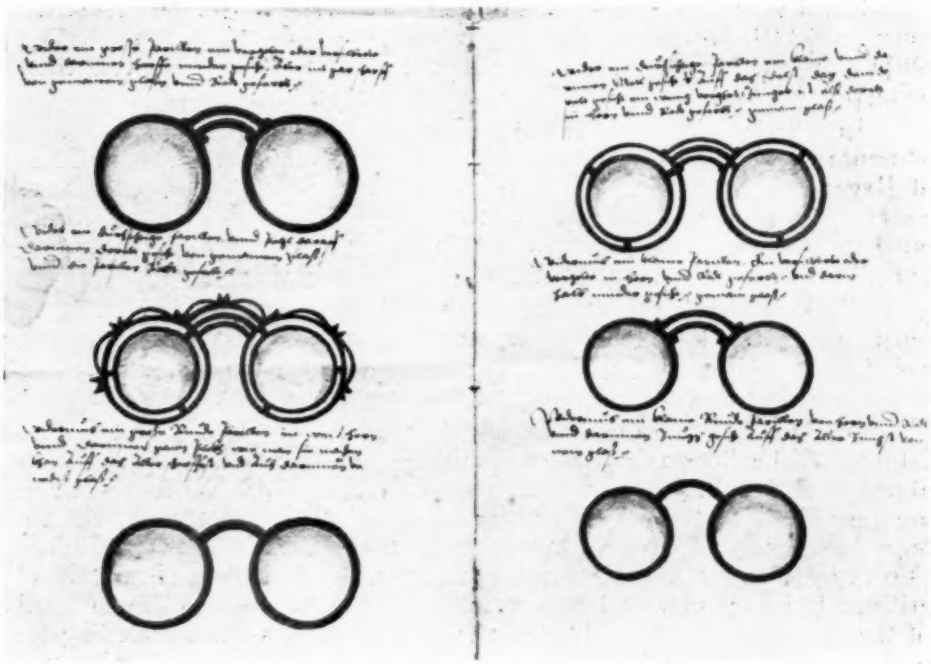

Fig. 5. Reproduction of other pages of the Regensburg Book.

In 1305, Giordano da Rivalto, a monk of Pisa, wrote, "It is not yet twenty years since the invention of spectacles, which secure better sight, one of the most useful arts in the world. I, myself, have seen and talked with those who first made them." Did he, too, have reference to Bacon?

In the same year, 1305, Gordon, professor of medicine in Montpelier, stated that "thanks to his excellent remedies, glasses were superfluous" and his contemporary Prof. Guido of Avignon who, after praising his remedies (Gordon's) more modestly remarked that "if they did not help, the need of glasses were indicated."

In the museum at Vienna is a statue of a man whose left hand is holding to the eyes a pair of glasses and the inscription:

"Here lies Salvina d' Armata degli Armati of Florence, the inventor of Spectacles"—"May God forgive his sins." He died in 1317.

In the monastery archives of St. Katherine of Pisa a manuscript gives the following—"Brother Alessandro della Spina, a modest and good man, learned all industrial products of which he saw or heard. Spectacles, which were made first by someone else, who did not want to communicate anything about them, were made by him and were distributed with a cheerful and benevolent heart." He died in 1313.

History tells that Pietro Buonparte, ambassador at the Austrian court in 1319, created a great sensation at the marriage of the Grand Duke's sister by appearing with a pair of spectacles on his nose, these being a recent invention of Salvina, called Armati.

In a letter from Dr. Hampe, Director of the Germanic National Museum of Nurnberg, he says, "Regarding the famous Opticians Guild of Regensburg, Bavaria, of which the Museum possesses an old Manuscript copy of the 16th century, twenty pages in folio (book form) with colored pen and ink drawings. This Opticians' Guild of Regensburg," he says, "has been often the object of scientific research."

The year of 1600 is given as the date of this manuscript and its purpose seems to have been to illustrate the various styles of spectacles, eye glasses and reading glasses then in vogue and to set forth certain standards regarding the manufacture and sale.

Also in the Germanic National Museum at Nurnberg, is the famous cabinet of the Spectacle Makers Guild. This cabinet, of wood, stands about four feet high by two and one-half feet wide. When the doors are opened, a center panel is revealed upon which, at the top, is the legend "Highly Honoured Members of the Spectacle Makers Guild." Directly below is a coat-of-arms consisting principally of a pair of griffons holding in their beaks a pair of spectacles. Below this is a list of the members, the individual's hall-mark or coat-of-arms preceding the name and the date of his admission following it. The first member was admitted in 1762 and the last in 1798.

The inside of the door panels have written on them in old German script, a blank verse record of the origin of glass and of the Guild. These verses are quite interesting and the literal translations are given.

LITERAL TRANSLATION OF LEFT PANEL

The city Phoenix has a river.
Five thousand steps wide, with name Pelus*
Near the city of Polemiaden
It flows into the sea.
When it by the means of the waves

*Early historians give this name as Belus, a river near Sidon.

Washes the sands, they become cleaned
Because it is cleaned in this manner
It looks as clear as beautiful glass.
Since several hundred years ago
Glass has been made, is certain and true.
To this place here came at one time, on a ship
Many merchants who brought salt-peter
While they on land a fire made
The salt-peter mixed with the sand
By such a manner that small streams flowed
Of clearest glass.
Plinius, Poloidorus,
Virgilius and Josephus write
"From the glass above described
Papilis the master made
Good lenses and perspectives
Through his invention and skill
To the advantage of mankind which one daily observes."
In spiritual and worldly professions
In the cities and in the country.
Over seas and over oceans
This profession has praise, standing and honor.

LITERAL TRANSLATION OF RIGHT PANEL

The Lens makers of Nurnberg
Have in the honored profession
These three masters highly praised
Individually such notice
Christoph Schmidt, Andreas Amon,
Who was the son of an old Master
Master Balthazer Schmidt selected—
Who was sworn in together with the other two Masters
To form at this time customs (regulations)
For an honourable profession.
Also to open a store (office) with a sign
In praise of the profession
Seeking peace and union,
As Syrach wished for young and old.
Then there existed in this city
The very wise councillors (city fathers)
From whom permission was obtained
To erect a guild building
For which permission—may God bless them
That one may enjoy
An honest trade at any time
Especially our descendants
Since nothing more beautiful exists in the world.

Than where one holds together
In peace and unity through God
As once with Abraham and Lot.
This surely will be blessed by God
Both here and elsewhere is certain and sure.

FREE TRANSLATION OF LEFT PANEL

Through the city of Phoenix there flows a river, five thousand steps wide, name Pelus. It empties into the sea near the city of Polemaiden. The action of the waves of the river sands clean them so thoroughly that they become beautiful as crystals. It is a known fact that the art of glass making had been known for several hundred years. When once a ship arrived bringing many merchants and a cargo of saltpeter. While on land they made fires, and it happened that the saltpeter blended with the sand in such a manner as to cause small streams of clearest glass to flow.

Plinius, Polidorus, Vircilius and Josephus write, "From the glass above described, Parilis, the master, used his skill and inventive powers to prepare good lenses and perspectives." It can be daily observed this has been to the advantage of mankind both in spiritual and worldly professions in cities and in the country.

This profession of lensmaking has achieved an honoured standing everywhere.*

FREE TRANSLATION OF RIGHT PANEL

In the year 1656 the spectacle makers of
Nurnberg had three outstanding members

In their esteemed profession. These renowned masters were Christoph Schmidt, Andreas Amon (who was the son of an old master lensmaker) and Balthazer Schmidt. They were sworn in and authorized to formulate rules and regulations for the profession. They were also commissioned to open a show room (exhibiton room—literally shop) with a sign aptly praising the profession. The aim was, as Syrach had desired, that peace and union should prevail between the members, both old and young. From the wise city fathers who had been approached, permission was obtained for the guild to erect their own building for which favor may God bless them. Through them one may enjoy an honest trade. Chiefly our descendants will benefit. Nothing more beautiful exists than untiy and peace, by the Grace of God, as was once with Abraham and Lot. This surely shall *be blessed by God*, both here and elsewhere.

It is interesting to note that the names of Christoph Schmidt, Andreas Amon and Balthazer Schmidt do not appear in the list of mem-

*In my first paper I called attention to the fact that Pliny 23-79 A. D. gave the discovery of glass to the Phoenicians who rested their cooking pots on blocks of natron (subcarbonate of soda) and found glass produced by the union, under heat, of the alkali and sand of the shore.—C. K. H.

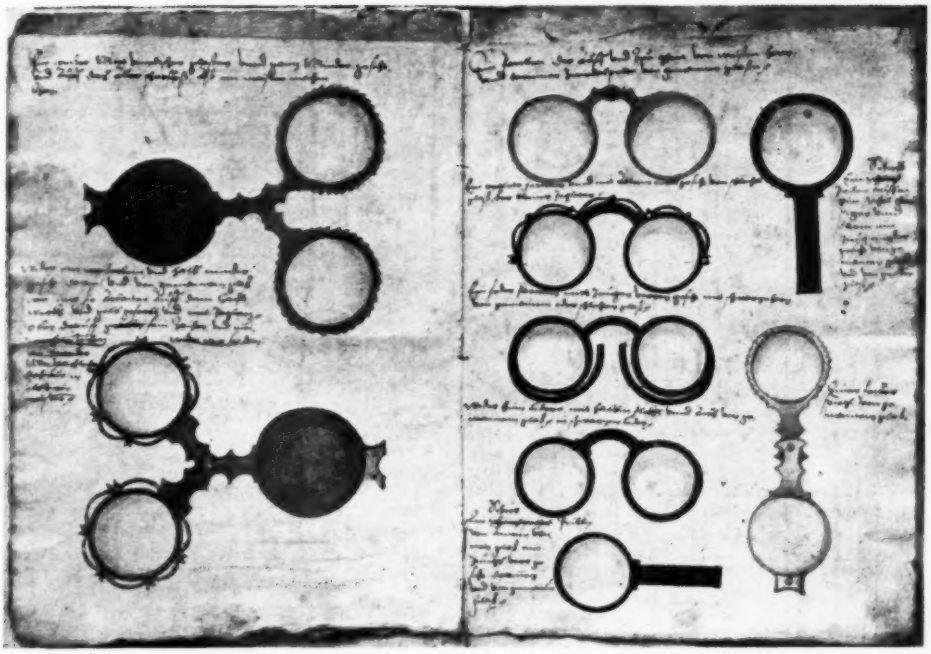

Fig. 6. Reproduction of other pages of the Regensburg Book. The accompanying description tells of what material is used and the use of the glasses.

bers given on the center panel, but that the rules and regulations which they were authorized to formulate for the government of the Guild is a part of the record.

The hand carved wooden chests of these three founders of the Guild are in the same Museum and bear the date of 1656, showing that these three practiced their profession and drew up the laws for an association over one hundred years before the first member was admitted.

Charles, the First, of England, in 1629 granted a charter to the "Masters and Court of the Worshipful Company of Spectacle Makers," and they were empowered to search premises used for spectacle making for "deceitful or counterfeit wares" and given the power to destroy such "Bad and Deceitful wares" and what is more, they had authority to call to their assistance any mayor, justice of the peace, sheriff, bailiff, or constable in such search. This charter has never been repealed. This ancient right of search was exercised in due form celebrating the Tercentenary of their charter two years ago in London. The right as described continued to be exercised in a modified form until recent times. Unfortunately, of the history of the Spectacle Makers of London before their incorporation no account exists, for their Hall and all their old records were destroyed in the great fire of London.

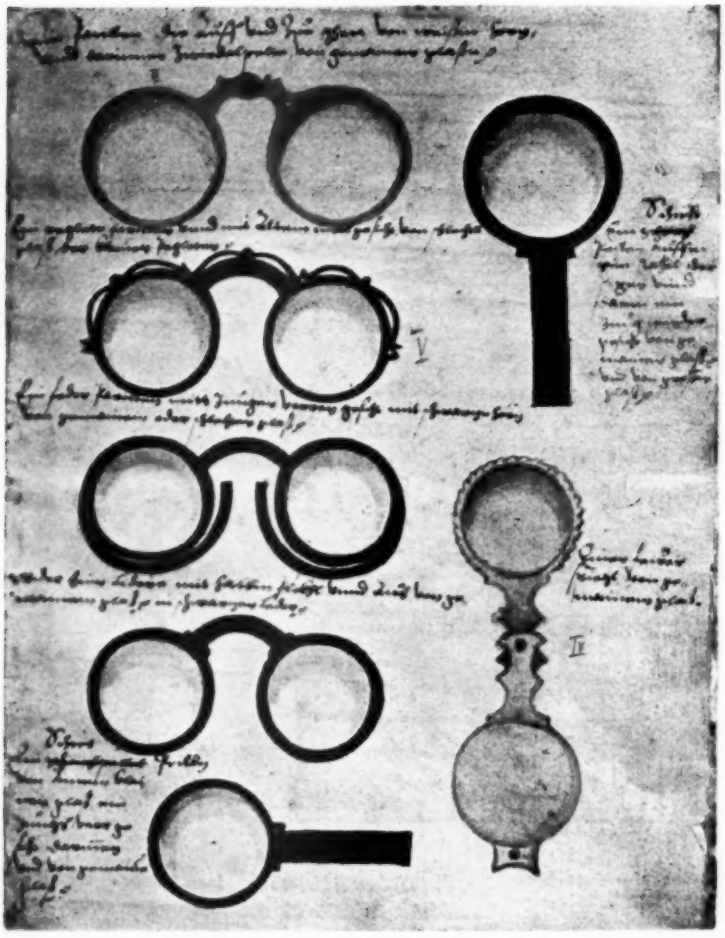

Fig. 7. Enlargement of the right hand page shown in Fig. 6.

Coming to our own country, it is said that one Peter Brown, a Pilgrim, was the first to bring spectacles from England. At this time, it is said, spectacles cost nearly $75.00. George Washington also wore glasses and the pair worn by him in 1789 are now in the Museum at Philadelphia. Benjamin Franklin is shown in nearly all of his portraits as wearing spectacles and he invented the old style split bifocal.

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THE EARLY RECOGNITION OF AUTO-INTOXICTION AND DIETIC DISTURBANCES THROUGH THE CONJUNCTIVA OF THE EYE—ITS VALUE IN CONSERVING, REBUILDING AND MAKING VISION COMFORTABLE*

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The presentaiton of this report is made after ten years of active use of the theories advanced, seeing beneficial results on hundreds of cases. These include hazy or cataractous crystaline lenses and medias cleared, central as well as peripheral vision improved, photophobia relieved even to the removal of number five smokes, symptoms of blepharitis, conjuntivitis, etc., relieved, return of color fields to normal, heterophorias corrected, myasthenia and epiphora relieved. While taking post graduate work at Ohio State University the last year Dr. Chas. Sheard was head of the Department of Optometry, the necessity for earlier recognition of ocular manifestations of systemic poisonings was agreed upon and we desire to give credit to that institution.

The theories we advance are based upon pathological conditions of the conjunctive of the eye and we believe this method recognizes systemic infection due to auto-intoxication and improper diet much earlier than is otherwise possible. We find this method makes a certainty of diagnosis not existent in other forms. Perimetry, innervational reserves and so on amplifying the diagnosis.

All text-books it has been our pleasure to review state that intestinal intoxication probably is not a frequent cause of eye disease and speaking in the narrow sense this is probably true, but during the years of research we here report on we have proven that digestive disturbances and faulty elimination do affect the eyes of a large percentage of those so afflicted.

J. H. Drakeford, Fellow of the American Academy of Optometry in the American Journal of Optometry February, 1931, is the only writer who has seemed to have sensed that to which we refer. Modern text-books stating that few diseases of the eye are caused by auto-intoxi-

*Reported before the California Optometric Research Institute October 22nd at the physics building, California Institute of Technology.

cation refer to the severe cases of Iritis, Cyclitis, Chorioditis, etc., while we refer to incipient conditions which if not corrected may lead to these graver conditions. A large percentage of these cases would be termed non-purulent, endogenous toxemias. The diagnosis of these incipient conditions will go a long way toward building the health of patients as well as prevent many chronic eye disorders and much discomfort.

We believe the early recognition of these chronic cases will do much toward the prevention of cataracts and in cases where cataracts are already forming will arrest the development. While it is not our purpose to report at this time, our researches made along with those upon which this report covers, strongly indicate that diffuse, hazy cataracts may be cured or partially cleared by the correction of faulty elimination and by correcting improper diet; also that there are cases diagnosed as degeneration of macular fibers in middle aged patients, having reduced central vision, but no fundus changes visible with the opthalmoscope, that are not at first true degenerative cases but are eliminative toxemias.

We know that some parts of the eye are rich in blood supply, also that some of the blood vessels are end organs. Therefor the purity of the blood supply is one with which we must concern ourselves if we are to conserve and give comfort to our patients vision.

All cases of improper elimination do not manifest themselves in the conjunctiva but remembering its blood supply we will readily realize the importance of the differential diagnosis when it does.

The conjunctiva of the upper lid (and the lids also) obtain its blood supply from two arterial arches, the arcus tarseus superior and the arcus tarseus inferior. The arcus tarseus inferior lies on the interior surface of the tarsus close to its border. To reach the conjunctive its branches perforate the tarsus from before backward above the free edge of the lid. The arcus tarseus superior lies a little above the tarsus and pass through the fascia tarso-orbitalis to reach the conjunctiva.

The conjuctive of the eyeball receives its blood supply chiefly from the vessels of the retrotarsal fold—the posterior conjunctival vessels; also from the anterior ciliary vessels. These latter vessels coming from the four recti muscles running under the conjunctiva to a point near the cornea where they disappear entering the eyeball through the sclera to supply the ciliary.

But before this happens, they give off branches ending in the limbus as vascular loops, directly at the margin of the cornea. This is of great importance to the cornea since it is chiefly responsible for its nutrition. Branches of the ciliary (the anterior conjunctival vessels) run backward in the conjunctiva toward the posterior conjunctival vessels anastomosing with them.

Reference has been made to the blood supply of the lid (the inferior and superior arcus tarseus). The veins of the lids are even more numerous, dense plexus being formed in each retrotarsal fold. The veins

of the lids in part empty into the veins of the forehead, into branches supply the ophthalmic vein. The latter in order to reach the veins of the orbit pass through the orbicularis.

Direct connection between the blood supply of the ciliary muscles and the conjunctiva is also of importance. Two branches of the posterior ciliary arteries (the long branches) directly supply the ciliary forming the circulus arteriosus iridus major. The anterior ciliary vessels, as we have seen entering the eyeball near the cornea from before backwards also helping to form the circulus arteriosus iridus major, supplying the ciliary and iris.

The blood supply of these parts arranged as it is, pathology of the conjunctiva certainly must, therefore, lead to the same condition existing in the ciliary bodies, iris and ocular muscles, and certainly must interfere with the proper nutrition to the cornea and crystaline lens.

These conditions of the conjunctiva, with the very probable involvement of the adjacent tissues supplied directly by the same arterial branches, are undoubtedly responsible for many cases of uncomfortable vision complained of by patients who have been made emmetropic and orthophoric.

Analyzing our subject we should remember that the conjunctiva is divided into three parts and that we have been discussing only that part known as the conjunctiva palpebral, mention only being made of the conjunctiva as a whole when having discussed its blood supply. Also that the normal conjunctiva contains low papillae, over which the epithelium passes undimpled, so that the conjunctiva is smooth. This continues up to the convex border of the tarsus, where the papillae becomes slightly higher and also takes on a slightly velvety appearance, also normally the thinness of the conjunctiva allows the meibomian glands to show clearly.

The typical characteristics of the palpebral conjunctiva in systemic infection due to auto-intoxication are hyperemia, a deep, intense, diffuse, uniformily red and velvety congestion; it is thickened and pavement like papillae are present, more profuse towards the retrotarsal folds, being present in the conjunctiva of the lower lids as well as the conjunctiva of the upper lids; calcareous deposits are present, also dried secretion in the form of granules amongst the lashes. Jaundice is frequently an accompaniment, but may be seen independently. In digestive disturbances the conjunctiva may have some of the other characteristics but in particular the injection is deep, intense and is differentiated by being spotty.

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NEUTRALIZATION IN DYNAMIC RETINOSCOPY*

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Dynamic retinoscopy, briefly defined, is that method of retinoscopy where the accommodation either alone or in association with the convergence is brought into play during the test. There are various ways and means of arousing and varying this accommodative activity and a number of techniques have been developed to meet such special needs. These techniques differ radically in many ways from the technique of static retinoscopy. It is the purpose of this article briefly to sketch one of these points of difference and its significance.

In static retinoscopy, our test ends when neutralization of the light-and-shadow movement is obtained. Some watch for actual neutralization, while others watch for the first light reversal, taking the lens just weaker as the one presumably giving neutralization. Whether we use the one method or the other, we always find that a stronger lens than the one that caused neutralization causes distinct reversal of movements. Thus if an initial "with" movement was neutralized with a plus 2·0 D., a plus 2·25 D. will cause a distinct "against" movement. Or, similarly, if an initial "against" movement was neutralized with a minus 2·0 D., a minus 2·25 D. will cause a distinct "with" movement. We therefore have to deal in static retinoscopy with but *one* neutralization lens.

It is quite different in dynamic retinoscopy. Here we generally have not one neutralization lens, but a series of such lenses, the lowest powered and the highest powered of this series being conveniently termed the low-neutral and the high-neutral respectively. Between these two we have the neutral range.

The following illustration will explain the foregoing. Say we make a binocular dynamic retinoscopy test by instructing the patient, who is already wearing his statically found correction, to fix binocularly the letters on a small chart attached just above the mirror of the retinoscope. The examiner preferably works along the median line of the patient, holding the retinoscope so that it is equally distant from the two eyes of the patient. From this position the examiner rapidly and

*Submitted for publication November 1, 1931.

alternately "refracts" each eye. The size of the type used on the fixation chart varies with the purpose of the test. This is a feature I shall briefly touch upon in the course of the discussion. Assume the test is made at a distance of 13 inches, necessitating a normal convergence of three binocular metre angles and three dioptres of accommodation.

Suppose we find in our test that the initial movement is "with." Say, with O. U. plus 1·0 D. (added to the distance correction) we get neutralization. We proceed with stronger plus lenses and continue to get neutralization until we reach say plus 2·5 D. when we get a definite "against" movement The first lens that gave neutralization was plus 1·5 D. We now have a low-neutral of plus 1·0 D., a high-neutral of plus 2·25 D, the strongest lens before reversal, and a neutral range of plus 1·25 D.

What is the significance of the low neutral, the high-neutral and neutral range? This depends upon various factors, viz., age, general vitality, occupation, working habits, refractive error, condition of the ocular muscles, etc. But in general, we can say this: The low-neutral represents accommodative *insufficiency*. For this "with" movement shows there was not enough accommodation used for the distance of the chart. It took a plus 1·0 D. to bring up the deficiency of accommodation. This deficiency is not necessarily absolute, rather is it relative to the amount of convergence used, in our illustration three binocular metre angles. The neutral range of 1·25 D. shows either accommodative *inefficiency* or negative relative accommodation depending upon the size of type used in the test. Where large type is used, such as can be distinguished under a blur of 0·5 D. to 1·0 D., then the neutral range represents inefficiency of accommodation. This is shown by the tendency of the accommodation to relax and let go as soon as plus power is applied to take its place. The inefficiency may be due to exhaustion incident to general bodily weakness or it may be due to a local condition such as beginning paresis. If the type used in the test is of the very fine variety such as to necessitate exact focussing, then the neutral range represents the negative relative accommodation. This is the amount of accommodation that can be forcibly relaxed with a fixed convergence in the interests of clear and single binocular vision.

When coarse type is used the high-neutral represents the strongest lens aid necessary in order to bring the accommodation and convergence into a comfortable, physiological adjustment. When fine type is used this lens represents the maximum value of the negative relative accommodation at the distance of examination. A small allowance of about 0·5 D. should be made in the above calculations because of a so-called lag of accommodation due, according to Prof. Southall, to the monochromatic aberration of the eye. Apart from this allowance it is a matter of judgment to decide whether or not the full value of the high-neutral is to be given as a reading addition in any particular case. But the fact is that the finding of these three values, the low-neutral, the

high-neutral and the neutral range will often clear up an obscure case of refraction where the correction based upon static retinoscopy, subjective testing and the subjective determination of the near point proved unsatisfactory.

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THE TREATMENT OF OCULAR FATIGUE

The subject of fatigue in general and occular fatigue in particular is of great interest to the optometrist, because of the fact that it causes certain physiological abnormalities to develop which are forerunners to the development of pathology. A close study of cases which come to optometrists will disclose fatigue to be the most outstanding.

Fatigue, from a physiological standpoint may be due to the exhaustion of substances used for cell nourishment and the increased production of the waste products. These waste products, which are claimed to be carbon dioxide, lactic acid and potasium phosphate acid, poison or depress the muscle. If any two of these products are to be injected into a fresh muscle, it will behave from the very beginning as if it were fatigued. From a psychological standpoint, fatigue may be caused by abnormal states in general and poor emotional adjustments in particular. We do not have any reliable test to discover existence of fatigue or measure its amount, hence, our only means for gaining information about this subject is the subjective method.

There are a number of points from which fatigue might occur[1] so as to lower activity: (1) fatigue of the muscle fibers, (2) fatigue of the nerve fibers, (3) fatigue of the motor cells, (4) fatigue of the junction of the motor nerve with the muscle fiber at the motor end plate, (5) fatigue of the synapses between the nerve cells, (6) fatigue

of the sense organs and different apparatus. (7) fatigue of the centers of voluntary control. The general symptoms of visual fatigue are a sensation of roughness, dryness, burning and smarting or feeling of foreign bodies in the eyes. To many patients these symptoms are natural indications that their visual apparatus is out of order and it is this that makes them go to the optometrist looking for relief.

To others again these symptoms merely indicate that the eyes need a rest and consequently they stop fatiguing work. Intra-ocular pain or headaches are definite symptoms of ocular fatigue. There is, it seems, a close association between the eye symptoms and the brain symptoms. This may be due to the fact that the brain is depending for its information from its advance guard—the eye. In considering "brain fatigue," we must bear in mind that there are several types of fatigue to be considered. They are according to Ladd and Woodsworth: First, the metabolic fatigue similar to that which exists in the case of the muscle. The second type of fatigue may be designated as "transferred metabolic." This results from the carrying of fatigue products by the blood from the muscle in which it is produced to some other organ which has been resting. This form of brain fatigue is real and is evidenced by the drowsiness and inability to do mental work immediately after severe muscular exercise. The third type consists of feelings and sensations of fatigue. While this may not be a true form of fatigue, it has at the same time a genuine inhibiting influence acting to cause the cessation of work, especially of the particular work which has been carried on. When a small group of muscles are repeatedly innvated, pain may develop in the muscles and their tendons. The tendency under this condition is either to stop the work or to change it to some other form whereby the action of some other group of muscles will be called into play. There is a considerable difference in metabolic fatigue, which actually lowers the functioning power of an organ, and the inhibitions which result from the action of certain stimuli to the organ. These inhibitions are in most cases the cause of mental fatigue. The symptoms of this last mentioned type of fatigue are, (a) loss of interest, (b) feeling of being bored, (c) a desire to change off and do something else, (d) inability to concentrate. *Brain Fatigue*, according to this discussion, *is a lowering of energy in the cerebral centers*. Work done under this condition wastes the cerebral stores of energy. Jackson claims that fatigue of the retina and visual centers is of more importance than all other forms connected with vision, on this point we can hardly agree with him, because from clinical experience and observation, we find that fatigue due to abnormal functioning of the ocular muscles is just as important and just as harmful. The fact that we cannot distinguish between the fatigue which belongs to the retina and that which belongs to the intro-cranial neurons or exernal muscles, will substantiate our claim. Also, it is a fact that co-ordination of each of the six muscles of the eye with each other is of prime importance in the proper functioning of the visual system, and the lack

of this co-ordination is largely responsible for the major part of ocular fatigue.

The stimuli to the muscles of the two eyes must be co-ordinated if binocular vision is to prevail. This condition of properly balanced stimuli cannot prevail when the energy flow of one or more nerves is slowed up due to existence of some toxic condition. It is important to differentiate the different types of fatigue and try to localize the essential changes that give rise to fatigue, also, we should not overlook the extremely important part that efforts of co-ordination play in producing ocular fatigue, claims. Jackson, this should prove useful in giving us a better conception of a condition that passes easily from a physiologic to a pathologic condition. When we once appreciate the importance of visual fatigue and co-ordination fatigue and their possible effects on the human system in general and the nervous system in particular, we begin to realize the importance of the adaptation of proper therapeutic measures, not only for the relief of the existing abnormalities, but for the removal of the fatigue causes as well.

Method of Treatment

In order to treat fatigue conditions properly, it is important that we know the cause responsible for this condition. While it is difficult to determine the exact causes of ocular fatigue, they all fall into two main classes:

1. Physiological,
2. Psychological.

Our refraction along with the subjective symptoms complained of by the patient should help us materially in classifying the case. If it is of a physiological nature, then our procedure should be (a) to correct the refractive error, if any, (b) to treat the muscular abnormalities, (c) to establish proper nerve energy flow by applying the proper type of electric current, (d) correcting the position or posture at which the work is being done.

If the case is of a psychological nature, then we may have to correct any one of the following conditions: (a) to provide proper illumination, (b) to change the surroundings and environment, the paint, the decorative scheme, the extreme color contrast may all be contributing causes, (c) mental attitudes and emotional adjustments. These may have to be carried out either at work or at home.

M. Luckiesh[2] is quite correct when he states that "the seeing specialist must open his mind to physiology as well as psychology."

J. I. K.

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[2] M. Luchiesh & F. K. Moss, Seeing. Published by William & Wilkins Co., Baltimore, Md.

ANNOTATIONS
AND
SOCIETY PROCEEDINGS

The American Journal of Optometry is the Official Organ of the American Academy of Optometry, as well as the Organ of the Arkansas, Delaware, Indiana, Iowa, Maine, Maryland, Michigan, Minnesota, Nebraska, North Dakota, Oklahoma, Pennsylvania, South Dakota, Vermont and West Virginia Optometric Associations.

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AMERICAN ACADEMY OF OPTOMETRY

The annual sessions of the American Academy of Optometry were held at Philadelphia on the 6, 7, and 8 of December. The faculties of the Pennsylvania State College of Optometry were used by the group and the following men delivered papers: Dr. O. L. McCullock, Dr. L. H. Kraskin, Dr. G. D. Oertel, Dr. O. J. Melvin, Dr. C. H. Johnson, Dr. E. LeRoy Ryer, Dr. Ernest Petry, Dr. Y. S. Nathanson, Dr. Wm. Feinbloom, Dr. E. F. Tait and Dr. John C. Neil. Following the round table dinner, Dr. Walter I. Brown of New Bedford, Mass., was re-elected Chairman with Dr. O. J. Melvin of Omaha, Neb., as Vice-Chairman and Dr. J. Fred Andreae of Baltimore, Md., as Secretary and Treasurer.

* * * * *

BETTER VISION INSTITUTE

Announcement has been made that the Better Vision Institute will spend one hundred thousand dollars in 1932 to develop eye consciousness on the part of the public throughout America. The American Optical Company has contributed twenty-five thousand dollars to this fund as have the Bausch and Lomb Optical Company. Twenty-five thousand dollars has been pledged by the wholesale distributors of material and the individual membership from the practitioners throughout America will make up the other twenty-five

thousand dollars. The Institute, through its radio broadcasting, has in the past done much to awaken the public to a greater need of ocular care and with this larger appropriation they should be in an even better condition to continue this splendid work in 1932.

* * * * *

SKEFFINGTON CLINICS IN IOWA

Dr. A. M. Skeffington of the Graduate Clinic Foundation will conduct a number of clinics throughout the state of Iowa from January 10th to January 30th. A registration fee of twenty dollars will be charged each participant and all optometrists are invited to attend the clinic held in the zone nearest his home. Dr. Skeffington is conducting these clinics in Iowa under the direction of the Iowa State Association of Optometrists.

* * * * *

SOUTH DAKOTA MEETING

Dr. C. C. Warren of Madison, S. D., spoke on "Ductions," Dr. J. J. Yager spoke on "The Subjective Examination" and Dr. Wm. Krawl spoke on "Building Public Confidence" at the regular monthly meeting of the Southern District of the South Dakota Association of Optometrists held at Parker, S. D., on December 8th.

* * * * *

MISSISSIPPI VALLEY SOCIETY

Dr. D. E. Hook of Des Moines, Iowa, addressed the Mississippi Optometric Society at Kewanee, Illinois, on Tuesday, December 1st. Dr. Hook spoke on the "Alexander Plan of Optometric Development."

* * * * *

PENNSYLVANIA STATE COLLEGE

Italian-American students of the Pennsylvania State College of Optometry have organized a club to assist this group at the school. The club is named Il Circolo Italiano of Optometry. Mr. G. D. Dragone, interne at the eye clinic and dispensary of the Pennsylvania State College of Optometry, has been elected president, Chas. D. Bertotto, vice-president; Salvie J. Fonte, secretary; A. G. DiGiacoma, treasurer; Anthony D. Venuto, chairman of the executive committee and Miss Antonia L. Cacano, chairman of the membership committee.

* * * * *

MAINE ASSOCIATION OF OPTOMETRISTS

The thirty-second annual meeting of the Maine Association of Optometrists will be held at the Eastland Hotel, Portland, Maine, on January 13th and 14th. Dr. Briggs S. Palmer, former chairman of the American Academy of Optometry will be the principal speaker at this meeting and a large attendance is expected.

INDEX—VOL. 8—1931

A

Absorption Lenses, C. C. Koch..... 209
Accommodation in an Aphakic Eye—Apparent, C. C. Koch..... 98
Advertising—Price, C. C. Koch..... 284
Amblyopia ex anopsia, C. C. Koch..... 137
Amblyopia and Strabismus, C. C. Koch.... 316
Approved list of Ophthalmologists, C. C. Koch 139
Astigmia—A case of Hyperopic Astigmia which developed into Compound Myopic, A. T. Wray..... 19
Astigmia—A Critique upon the Case of Hyperopic Astigmia which developed into Compound Myopic Astigmia, F. Mc-Fadden 66
Astigmatism, D. R. Paine..... 202
Astigmatism—Marked Change after Tonsilectomy, C. I. Saks..... 118
Attention and Motivation in Ocular Work, T. H. Eames..... 35
Auto-Condensation Current an aid in building Adduction, J. I. Kurtz..... 63
Auto Drivers Tests, C. C. Koch..... 174
Auxiliary Aids in Unusual Cases, E. LeRoy Ryer and E. E. Hotaling..... 38

B

Baxter, J. O., Impossible Corrections..... 114
Bennett, R. W., Iridology..... 377
Bifocal Wearers — Instructions to, C. C. Koch 172
Bifocals and Golf, C. C. Koch..... 178
Blur Points, L. Jaques..... 251

C

Cataract, B. T. Hoffman..... 86
Cataract Phophylaxis, E. LeRoy Ryer and E. E. Hotaling..... 131
Case Analysis, C. W. Shepard and W. A. Mendelsohn 222
Clinical Training and Educational Degrees, C. C. Koch..... 101
Clinics—Organizing Free Eye, C. C. Koch.. 141
Coloboma of the Iris, W. Feinbloom and J. A. Pruzan..... 287
Color Field Work, M. M. Ocshier..... 215
Costa, T., Myopia..... 360

D

Dental Sepsis—Vision as affected by, W. H. Wilkins and Geo. W. Keevil..... 93
Diet—Visual Acuity Improved by Changing, M. Steinfeld..... 279
Doane, H. C., Perimetry..... 327
Drakeford, J. H., Focal Infection..... 58
Duction Findings, A. M. Skeffington..... 406
DuPlessis, G. L. Squint..... 345
Dynamic Retinoscopy, J. I. Pascal..... 143

E

Eames, T. H., Attention and Motivation in Ocular Work 35
Exophoria—Juvenile, W. S. Farmer..... 277

F

Focal Infection, J. H. Drakeford..... 58
Farmer, W. S., Juvenile Exophoria..... 277
Feinbloom, W., Telescopic Spectacles..... 146
Feinbloom, W. & J. A. Pruzan, Coloboma of the Iris..... 287
Fording, H. L., Some Thoughts on Geometrical Optics 41-81-162

G

Geometrical Optics — Some thoughts on, H. L. Fording.....41-81-162
Gilbert, M., An opaque Haloid Canal..... 315
Glare, W. E. Pell..... 121
Glazed Spectacles from the Rubbish Heap, C. C. Koch..... 248

H

Hall, R. M., Strabismus..... 289
Headaches—Ocular, B. T. Hoffman..... 10
Hoffman, B. T., Cataract 86
Hoffman, B. T., Ocular Headaches..... 10
Hotaling, E. E. and Ryer, E. LeRoy, Auxiliary Aids in Unusual Cases..... 38
Hotaling, E. E. and Ryer, E. LeRoy, Cataract Prophylaxis 131
Hyaloid Canal—An Opaque, M. Gilbert.... 315

I

Impossible Corrections, J. O. Baxter..... 114
Iridology, R. W. Bennett..... 377

J

Jaques, L., Blur Points..... 251

K

Keevil, G. W. and Wilkins, W. H., Vision as affected by Dental Sepsis..... 93
Koch, C. C., Absorption Lenses 209
Koch, C. C., An Approval list of Ophthalmologists 139
Koch, C. C., Amblyopia ex anopsia 137
Koch, C. C., Apparent Accommodation in an Aphakic Eye..... 98
Koch, C. C., Auto Drivers Tests..... 174
Koch, C. C., Bifocals and Golf..... 178
Koch, C. C., Bifocal Wearers—Instructions to 172
Koch, C. C., Clinical Training and Educational Degrees 101
Koch, C. C., Glazed Spectacles from the Rubbish Heap 248
Koch, C. C., Myopia—The Correction of... 171
Koch, C. C., On the Doubtful Procedure of treating Refractive Errors without lenses 26
Koch, C. C., Optometric Advertising..... 104
Koch, C. C., Organizing Free Eye Clinics.. 141
Koch, C. C., Ophthalmoscopic Examination 245
Koch, C. C., Strabismus and Amblyopia... 316
Koch, C. C., The Treatment of Myopia.... 433
Kraskin, L. H., Psychology and Optometry. 119
Kurtz, J. I., A New Conception on Physical Therapy Needed 212
Kurtz, J. I., Auto-Condensation Current an aid in Building Adduction..... 63
Kurtz, J. I., Ocular Physical Therapy in England and America..... 397
Kurtz, J. I., Physical Therapy 229-414
Kurtz, J. I., Progressive Muscular and Nerve Atrophy due to Brain Tumor..... 349

L

Levin, N., The Anomalies of the Phoria.... 1
Light Change gives new Atomic View, R. W. Wood 28

Mc

McFadden, F., A Critique upon the case of Hyperopic Astigmia which developed into Myopic Astigmia 66
McFadden, F., Strabismus Case..... 198

M

Mason, F. L., Amplification of the range of an Ophthalmometer 107
Mendelsohn, W. A. and C. W. Shepard, Case Analysis 222
Mental Processes Worthy of Science and Optometry, C. R. Padelford..... 267
Myologic Diagnosis, L. K. Wyatt..... 399
Myopia, T. Costa..... 360
Myopia, The treatment of, C. C. Koch..... 433
Myopia, C. Saks 281
Myopia—Prism treatment of Functional, E. F. Tait..... 123
Myopia—The Causation of, C. C. Koch.... 171

N

Near Vision, The Acuity of (abst.)..... 30
Neumueller, J., Presbyopia..... 361

O

Ocshier, M. M., Color Field Work..... 215
Ocular Physical Therapy in England and America, J. I. Kurtz..... 397
Ophthalmometer — Amplification of the Range of an, F. L. Mason..... 107
Ophthalmoscopic Examination, C. C. Koch 245
Optometric Advertising, C. C. Koch..... 104

P

Padelford, C. R., Mental Processes Worthy of Science and Optometry..... 267
Padelford, C. R., Physical Therapy..... 426
Paine, D. R., Astigmatism..... 202
Pascal, J. I., Diplopia in the treatment of Strabismus 24
Pascal, J. I., Dynamic Retinoscopy..... 143
Pearce, R. J., A Report of the Southeastern Congress of Optometry.....319-353
Peckham, R. H., Visual Acuity Tests..... 323
Pell, W. E., Glare..... 121
Perimetry, H. C., Doane..... 327
Phoria Findings, A. M. Skeffington..... 406
Photography as Applied to Strabismic Conditions, E. G. Wiseman..... 255
Physical Therapy, J. I. Kurtz.....229-414
Physical Therapy, A new Conception Needed, J. I. Kurtz..... 212
Physical Therapy, C. R. Padelford..... 426
Plane Reflecting Surfaces—On Systems of, T. Smith 29
Psychology and Optometry, L. H. Kraskin.. 119
Phoria—The Anomalies of the, N. Levin... 1
Presbyopia, J. Neumueller..... 361
Price Advertising, C. C. Koch..... 284
Progressive Muscular and Nerve Atrophy due to Brain Tumor, J. I. Kurtz..... 349
Pruzan, J. A. & W. Feinbloom, Coloboma of the Iris..... 287

R

Red Free Lenses in Cataract Prophylaxis, E. LeRoy Ryer and E. E. Hotaling..... 131
Refractive and Pathological Symptoms in the Eye, W. Smith..... 71
Retinoscopy—Dynamic, J. I. Pascal..... 143
Ryer, E. LeRoy and Hotaling, E. E., Auxiliary Aids in Unusual Cases..... 38
Ryer, E. LeRoy and E. E. Hotaling, Cataract Prophylaxis 131

S

Saks, C. I., Disappearance of Scotoma and Marked Change of Astigmatic Correction After Tonsilectomy 118
Saks, C. I., The Causation of Myopia..... 281
Scotoma, C. I. Saks..... 118
Shepard, C. W. and W. A. Mendelsohn, Case Analysis 222
Skeffington, A. M., Phoria and Duction.... 406
Smith, T., On Systems of Plane Reflecting Surfaces 29
Smith, W., Refractive and Pathological Symptoms in the Eye..... 71
Southeastern Congress of Optometry — A Report, R. J. Pearce.....319-353
Squint, G. L. DuPlessis..... 345
Steinfeld, M., Visual Acuity Improved by Changed Diet 279
Strabismic Case, F. McFadden..... 198
Strabismic Conditions — Photography Applied to, E. G. Wiseman..... 255
Strabismus, R. M. Hall..... 289
Strabismus and Amblyopia, C. C. Koch.... 316
Strabismuc—Diplopia in the Treatment of, J. I. Pascal..... 24

T

Tait, E. F., Prism Treatment of Functional Myopia 123
Tait Technique, A. C. Whitaker..... 179
Telescopic Spectacles, W. Feinbloom..... 146
Treating Refrative Errors without Lenses—On the doubtful Procedure of, C. C. Koch 26

V

Visual Acuity Tests, R. H. Peckham..... 323
Visual Acuity changed by Improved Diet, M. Steinfeld 279

W

Whitaker, A. C., Tait Technique..... 179
Wilkins, W. H. and Geo. W. Keevil, Vision as Affected by Dental Sepsis..... 93
Wiseman, E. G., Photography as Applied to Strabismic Conditions 255
Wood, R. W., Light Change Gives New Atomic View 28
Wray, A. T., A Case of Hyperopic Astigmia which Developed into Compound Myopic Astigmia 19
Wyatt, L. K., Ocular Myologic Diagnosis... 399

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